7

Tools, Equipment and Accessories

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Objectives

Upon completing this lesson, you will be able to:

1. Define tools, equipment and accessories (TEA).
2. List four categories of TEA according to their use.
3. List five power sources for equipment and tools.
4. List the general steps for use and maintenance of tools and equipment (before, during and after their use).
5. Demonstrate in four practical exercises the correct use of TEA.

Approximate Duration:

– Lecture: 45 minutes
– Practical component: 5 hours 15 minutes

1. Definitions

1.1 Tools

A tool is a device that is used to perform or facilitate manual or mechanical work, using only the ***strength*** of the operator.

Examples:.....

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1.2 Equipment

A piece of **equipment** is a machine or device that performs a physical task, whose operation depends on an ***external power source*** in order to increase work capacity.

Examples:.....

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1.3 Accessories

An **accessory** is a component that ***supplements*** or ***completes*** a tool or piece of equipment, and which increases the operator's ability to perform a task.

Examples:.....

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2. Classifying Tools, Equipment and Accessories According to their Use

2.1 Search TEA

Search tools, equipment and accessories are used in ***searching*** for potentially trapped victims and locating them in collapsed structures. They can be used individually or in conjunction with each other.

2.2 Rescue TEA

Rescue tools, equipment and accessories are those used to ***penetrate*** a structure and gain access to a victim in a CSSR operation (Figure 1).

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Figure 1. Rotary rescue saw (K-12) and reciprocating saw.

2.3 Operations Support Equipment and Accessories

This category includes all items and devices used to ***aid*** in conducting a CSSR operation and which ***support*** rescue activities (Figure 2).

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Figure 2. Electric generator and hand-held two-way radios.

2.4 Personal Protective Equipment

Personal protective equipment (PPE) is required in order to ***prevent*** injuries while working on a CSSR operation. Some basic PPE items are shown below:

3. Classifying Tools and Equipment According to Power Source

3.1 Electric-powered

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Figure 3. Electric drill and circular saw.

3.2 Pneumatic (Air-Powered)

Figure 4. Pneumatic (air) chisel.

3.3 Internal Combustion

Figure 5. Electric generator.

3.4 Hydraulic

Figure 6. Hydraulic bottle jacks.

3.5 Other Types

Figure 7. Hoist (come-along).

Classifying Tools, Equipment y Accessories	
According to Use	
Search	Examples:
Rescue	Examples:
Operational Support	Examples:
According to Power Source	
Electrical	Examples:
Air Powered	Examples:
Internal Combustion	Examples:
Hydraulic	Examples:
Other	Examples:

4. General Steps for Use and Maintenance

There are seven general steps you should follow when using any tool or piece of equipment in a CSSR operation. These steps are in addition to the specific instructions for each particular tool or piece of equipment.

Before

a. Put on all required PPE.

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b. Verify availability of fuel and power sources.

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c. Verify proper operation of tool.

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d. Check required accessories for each tool or piece of equipment.

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e. Follow all safety rules (course rules and manufacturer's rules).

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During

f. Use proper technique when using a tool or piece of equipment.

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After

g. Follow proper cleaning and maintenance procedures for each tool or piece of equipment.

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Power Tool Tips

Follow these important guidelines when using power tools:

- Always use the proper bit or blade for the material to be penetrated and make sure that it is firmly installed in the tool before operating.

- Do not operate a drill until it is in contact with the material to be penetrated.

- Conversely, when operating a rotary saw, bring it up to full speed **before** making contact with the material to be penetrated.

- When drilling, do not stop the drill while the bit is inside the material – doing so may cause the bit to jam in the material. Likewise, do not allow the blade of a rotary saw to come to a stop while cutting material – remove it fully first.

- If a drill bit becomes jammed in the material and you are unable to remove it with normal drill action, **do not** use the whole drill as a lever on the bit – remove the drill from the bit and try to loosen it with hand tools.

EQUIPMENT MONITORING FORM

Description:	**Brand:**
Model:	**ID Tag:**
Serial #:	**Date of Purchase:**
Cost:	**Warranty Expiration Date:**
Repair Company:	
Additional Specifications:	
Accessories:	

Maintenance Log			
Date	**Description of Work Performed**	**Technician**	**Labour Warranty Expiration Date**

Use Log			
Date	**Amount of Time Used**	**Operator**	**Comments**

8

Rescue Strategies and Techniques

<< Instructor's Copy >>

Objectives

Upon completing this lesson, you will be able to:

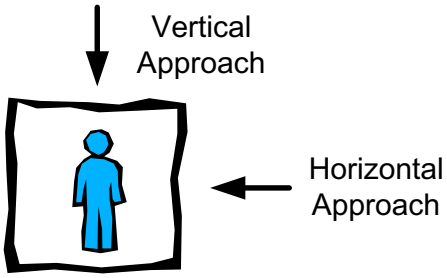
1. Describe the two ways of approaching a located trapped victim.
2. List the four techniques for accessing and rescuing a victim.
3. List the five factors to analyse when evaluating access conditions.
4. List the steps for removing rubble.
5. Describe the procedures for penetrating five different materials: wood, metal, concrete, brick and cinder block.
6. Demonstrate in a practical exercise the procedure for removing rubble, and cutting and penetrating the five materials listed above, correctly using the required tools.

Approximate Duration:

– Lecture: 2 hours
– Practical component: 5 hours, 15 minutes

1. Approach Strategies

Once the search has ended and the trapped victim has been located, it is then necessary to make a decision on how to approach the victim.



Vertical approach

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Horizontal approach

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APPROACH STRATEGIES		
	Advantages	**Disadvantages**
Vertical	• Body position is more comfortable • Easier to use tools and equipment • Easy access • Cleaner work conditions	• Likely to work with concrete • Debris may fall on the victim • Time-consuming • Must ensure piece being cut does not fall on the victim
Horizontal	• Easy penetration • Material in most cases is not concrete • Debris does not fall on the patient	• Uncomfortable body position • Crawling frequently required • Tool positioning awkward • Dirtier working conditions • Aftershocks risky to rescuer

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Figure 1. Vertical approach.

Figure 2. Horizontal approach.

2. Access and Rescue Techniques

2.1 Removing rubble

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2.2 Shoring

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2.3 Cutting and penetrating

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2.4 Lifting and stabilising loads

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3. Evaluating Access Conditions

At this point, the search has been conducted and victims located. Now the focus is to analyse ***access points*** to make sure the route is safe for victim extrication efforts to begin. The following five steps must also be taken:

a. Ensure utilities are cut off.

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b. Proceed to victim marking location.

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c. Mitigate hazards.

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d. Establish safety zones and escape routes.

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e. Secure your access area and remove rubble.

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4. Removing Rubble

When victims are trapped near the surface of a collapsed structure, you will need to remove the rubble surrounding them in order to extricate them. It is very important to be very ***methodical*** and work ***gradually*** when removing rubble. Use the following procedure:

CAUTION: Be careful not to move pieces that may affect the stability of the structure or rubble pile. When in doubt, consult a structural engineer.

1. Determine the manner in which the building collapsed and verify the condition of its components.

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2. Remove small pieces first and only large pieces that may be loose. Never remove any pieces that are **under pressure** or **wedged** in place.

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Figure 3. Rubble removal following an earthquake.

3. To remove pieces that are under pressure it may be necessary to shore first.

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4. Avoid cutting into load-bearing walls.

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Note: Simple methods such as a bucket brigade may be very effective for removing rubble.

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Figure 4. Rubble removal following an earthquake.

5. Procedures for Cutting and Penetrating Materials

When breaching a wall or floor, always be aware that a ***trapped victim*** may be in direct contact with the other side of the material you are cutting through. Therefore, you must use extreme caution when cutting and penetrating to avoid accidentally injuring the person you are trying to save. Additionally avoid cutting too deeply to prevent damaging ***structural elements***, wires, water pipes, etc.

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To properly select a tool for a task, you should have a good understanding of the capabilities and limitations of the tools available to you. You must always work within the capabilities of the tool and use it properly.

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5.1 Cutting and Penetrating Metal and Wood

Several tools and pieces of equipment are used in cutting and penetrating metal and wood:

Tools for Cutting Metal	Tools for Cutting Wood
• Tin snips • Bolt cutters • Hacksaw • Reciprocating saw • File • Power drill • Rotary rescue saw • Circular saw (with metal-cutting blade) • Air chisel • Acetylene torch	• Axe • Hatchet • Hand saw • Power drill or hand drill • Chainsaw • Circular saw • Reciprocating saw • Rotary rescue saw

Figure 5. Cutting sheet metal.

Figure 6. Cutting a wood panel.

Procedure for Cutting Metal and Wood

1. Use full PPE.

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2. Select the proper tool.

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3. Make the work area is free of hazards.

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4. Knock on the metal or wood to find a hollow area.

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5. Make an inspection hole. Use caution when breaking through the other side.

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6. Cut a triangular access hole, large enough to permit access. Additionally avoid cutting too deeply.

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7. Remove the piece you have cut. Protect against any sharp edges by filing, covering them, or bending the metal back.

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8. Shore if necessary.

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5.2 Cutting and Penetrating Concrete Block and Brick

The procedure discussed in this section refers to vertical walls that are still in or close to their original position. Penetration is horizontal. Other techniques would be used for these materials when collapsed or in a horizontal position.

A word of caution: It is best to avoid cutting through walls. Breaching through unreinforced masonry (URM) walls may cause ***additional collapse*** or building instability. Instead, you should look for existing natural or created horizontal openings.

Tools for Cutting Brick and Concrete Block
• Large and small sledgehammer • Chisel • Pick • Pry bar or crowbar • Chipping hammer • Impact hammer • Impact drill • Rotary hammer drill • Rotary rescue saw

Figure 7. Breaching concrete block.

Procedure for Cutting and Penetrating Concrete Block and Brick

1. Use full PPE.

2. Select the proper tool.

3. Make sure the work area is free of hazards.

4. Make an inspection hole. Use caution when breaking through the other side.

5. Break into the block or brick, cutting a triangular hole, starting at the bottom (base of triangle). Additionally avoid cutting too deeply.

   With concrete block, first break into the hollow area (cell), which is weaker. With bricks, first break into the mortar between the bricks.

6. Remove the broken pieces. Always move the pieces out of the hole; do not push them in.

7. Shore if necessary.

Figure 8. Breaching a brick wall.

5.3 Cutting and Penetrating Reinforced Concrete

Tools for Cutting Reinforced Concrete	
• Large and small sledgehammer • Chisel • Pick • Pry bar or crowbar • Chipping hammer • Impact hammer • Impact drill • Rotary hammer drill • Rotary rescue saw	**For cutting steel reinforcements:** • Reciprocating saw • Hacksaw • Bolt-cutter • Acetylene torch

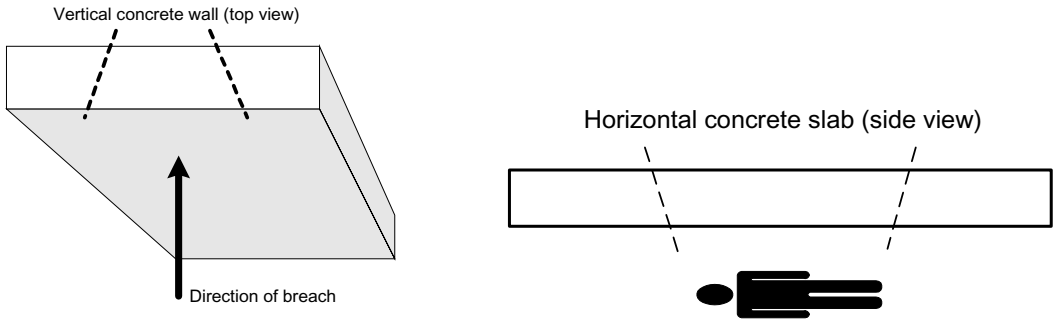

Figure 9. Cut concrete at an angle to prevent loose piece from falling on or toward victim.

Procedure for Cutting and Penetrating Reinforced Concrete

Cable reinforcements need to be identified early to ensure the rescue team can recognise the difference between cables and rebar. Cutting pre-tensioned cables can result in the immediate failure of the slab or ***structural member***. Generally, rescue teams should not cut tensioned cable or should cut them only under the direction of a structural engineer.

1. Use full PPE.

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2. Select the proper tool.

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3. Make sure the work area is free of hazards.

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4. If possible, make an ***inspection hole***. Use caution when breaking through the other side.

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5. **Horizontal approach:** Your goal is to cut a ***triangular*** hole in the concrete.

   a. Make the two upper cuts at a slight angle off perpendicular (80-85 degrees). This will prevent the cut portion from falling inward, where it could potentially injure a victim.

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   b. If the concrete is thicker than the depth of the saw blade, begin chiselling and remove pieces, starting from the bottom (base) and working upward.

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Figure 10. Breaching on horizontal approach.

6. **Vertical approach:** Your goal is to cut a ***square/rectangular*** hole in the concrete.

   a. Make a small hole in the centre of the piece you will be cutting out, that you will use to lift the cut portion.

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   b. Cut two opposing sides of the square at a slight angle off perpendicular (70-80 degrees). This will later prevent the cut portion from falling downward.

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   c. Complete the square by cutting the remaining two sides in a normal perpendicular fashion.

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d. Then lift out the piece using the hole in the centre. If the concrete is thicker than the depth of the saw blade, you will need to chisel and remove pieces.

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Figure 11. Breaching during a vertical approach.

7. **Cutting reinforcements:** A different approach is required when encountering reinforced concrete with steel rebar or stranded cable. Loosen the concrete around the rebar to make room for tools. Then you can use a reciprocating saw, bolt cutters, rebar cutters or a torch to cut the individual bars away. If for any reason it becomes necessary to cut cables, you should use a ***torch*** to cut **one strand at a time** to allow for slow de-tensioning.

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8. Shore if necessary.

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9

Shoring Methods

<< Instructor's Copy >>

Objectives

Upon completing this lesson, you will be able to:

1. Define shoring and identify its components.
2. List the factors that determine the design and method of shoring.
3. Describe four types of shoring.
4. List the positions and functions of the members of a shoring team.
5. List the procedures for building a window/door shore and a vertical shore. Demonstrate these procedures in a practical exercise.

Approximate Duration:

– Lecture: 1 hour, 30 minutes
– Practical component: 5 hours, 30 minutes

Sample window/door shore.

1. Shoring

The temporary support of only that part of a damaged, collapsed, or partly collapsed structure that is required for conducting search and/or rescue operations at reduced risk to the victims and rescue team.

Shoring can also be applied to the following:

a. Structures with severely damaged panels
b. Structures with loose pieces of concrete
c. Cracked or broken pre-fabricated panels
d. Cracked masonry walls

Shoring follows a **Double-Funnel Principle**, which means that a shore collects a load, channels it and redistributes it safely to another surface or structure that can support it.

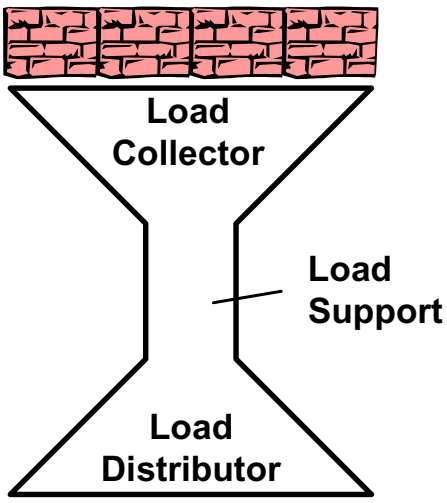

Figure 1. Double-funnel principle.

Components of a Shore

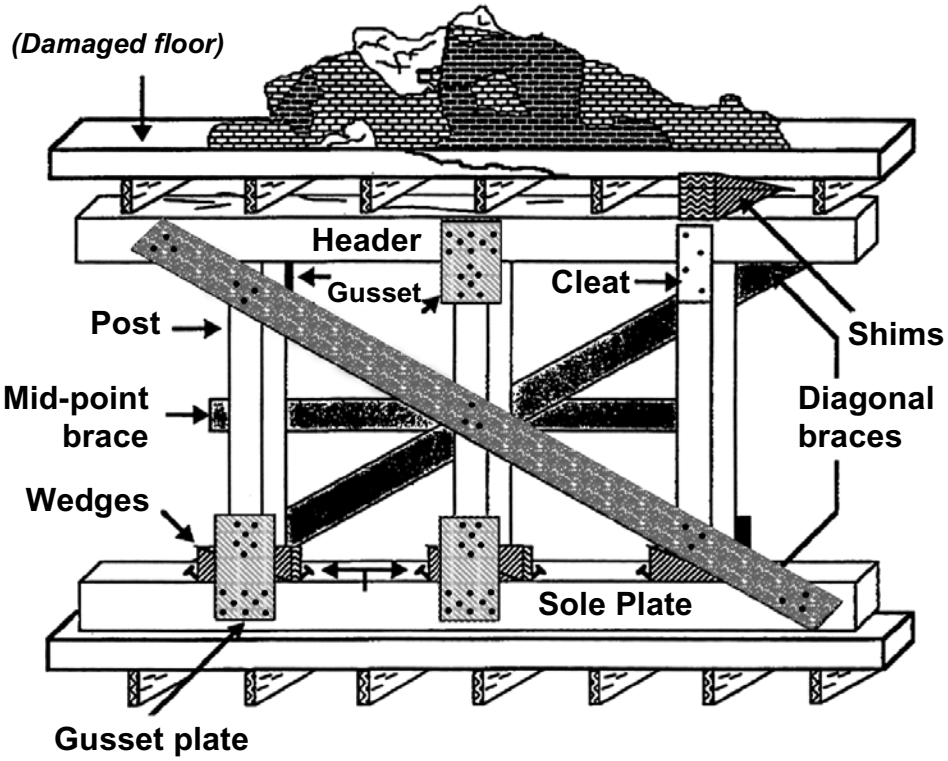

Figure 2. Sample vertical shore.

Label the components of the vertical shore above as the instructor describes them and write in their descriptions and functions below.

- **Sole plate:** provides a ***foundation*** for the shoring system by supporting the weight being transferred from above and ***distributes*** it over a wider area.

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- **Header beam:** collects the weight from ***above*** and spreads it throughout the shoring system.

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- **Post:** supports the weight collected by the ***header*** and transfers it to the ***sole plate*** where it is distributed.

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- **Diagonal bracing:** locks the entire shoring system together as one unit, supporting against possible ***eccentric*** loads. It is the last component to be installed.

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- **Gusset plate:** a small piece of **13 mm** or **18 mm** plywood nailed to the ***top*** and ***bottom*** of posts to aid in placement of the header and secure the posts to the header and sole plate.

- **Wedges/shims:** two wooden inclined planes married together and placed under the bottom of the ***posts***. These provide compression for the shoring system. The shim is a single wedge used to fill in gaps above the shoring system.

2. Determining Factors

A variety of factors will determine what method of shoring is required in a particular situation.

a. Weight of construction materials

b. Weight of the structural elements to be supported

c. The normal load capacity of the existing undamaged structure

d. Condition of the structure to be supported

e. Condition of the foundation and floor/surface angle to determine stability of shoring

f. Availability of shoring materials

g. Lateral and vertical instability

3. Types of Shoring

3.1 Vertical

The main purpose of the vertical shore is to ***stabilise*** damaged floors, ceilings or roofs. It can also be used to ***replace*** missing or unstable bearing walls or columns.

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VERTICAL SHORE SPECIFICATIONS with 10x10 cm post, header and sole plate			
Maximum Height	**Maximum Distance Between Posts**	**Maximum Overhang**	**Load-Bearing Capacity per Post**
2.5 m (8'0")	**1.25 m (4'0")**	**60 cm (2'0")**	**3,600 kg (8,000 lbs.)**
3.0 m (10'0")	**1.50 m (5'0")**	**80 cm (2'6")**	**2,270 kg (5,000 lbs.)**
3.7 m (12'0")	**1.80 m (6'0")**	**90 cm (3'0")**	**1,600 kg (3,500 lbs.)**

3.2 Window/Door

This type of shore supports a window or door that is in danger of collapse. Diagonal braces are only used when the opening is not needed for ***access*** or ***egress***.

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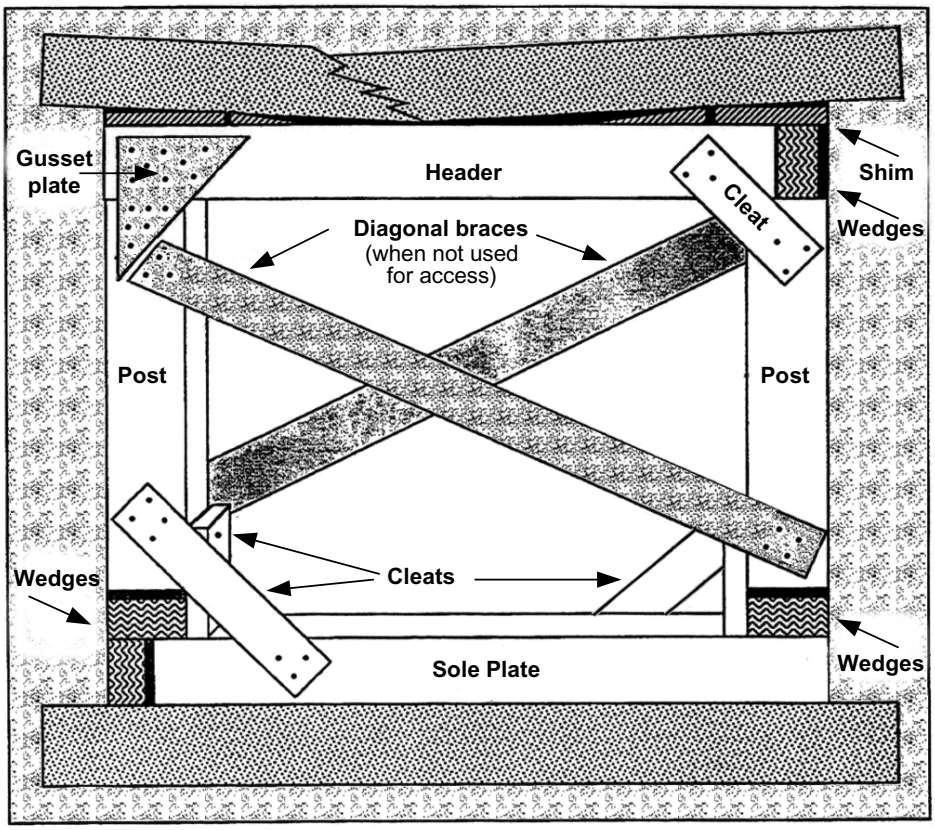

Figure 3. Typical window/door shore.

3.3 Other Types of Shoring

Several additional types of shores can be used in collapsed structures, though they will not be taught in this course. Your reference material discusses them in further detail. Some examples include:

- **T-Spot Shore:** The main purpose of the T-shore is to initially stabilise damaged floors, ceilings or roofs, so that the more substantial shoring can be constructed at less risk. This shore is _____ _____ and only ***temporary***, also used during quick extrication of a victim.

- **Raker Shore:** A triangular system of shoring used to support leaning or unstable walls or columns. Rakers must always be installed in series; at least ***two*** must be erected in any given situation.

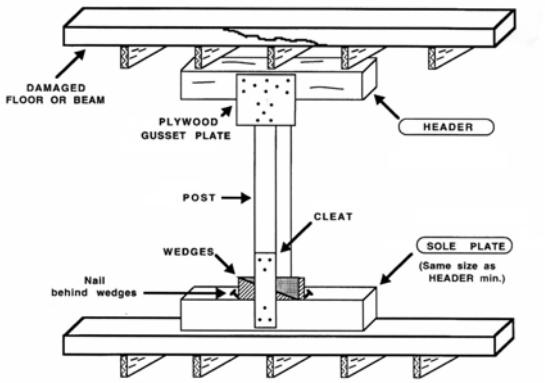

Figure 4. T-Spot shore.

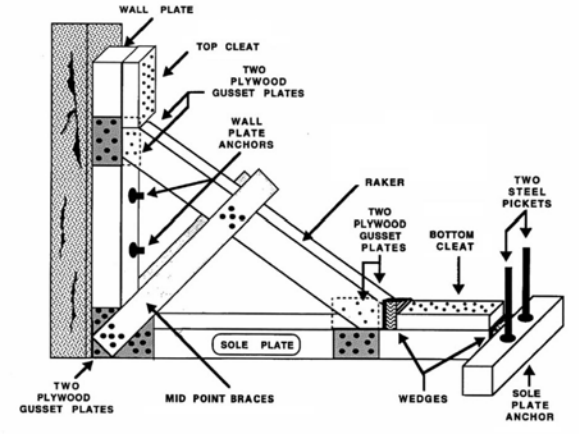

Figure 5. Raker shore.

- **Laced Post Shore:** A high-capacity, four-post system that is used to support sagging floors and ceilings, or other overhead hazards. It can be used as a safe haven.

- **Horizontal Shore:** Used to stabilise a damaged wall against another undamaged wall in hallways, corridors or between buildings.

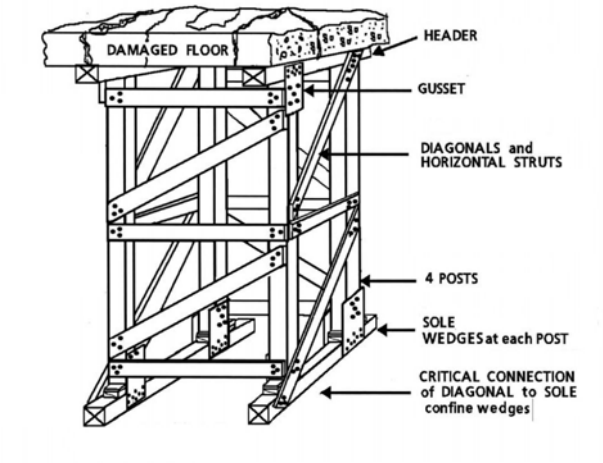

Figure 6. Laced post shore.

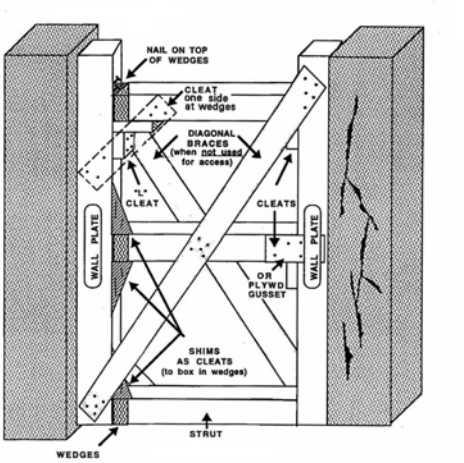

Figure 7. Horizontal shore.

Sometime people have to improvise shoring methods, as dictated by the availability of materials. A building shored with bamboo is shown in the pictures below.

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4. Members and Functions of a Shoring Team

If sufficient manpower were available, a shoring team could be organised using two separate 6-person squads, one squad as an assembly team and another as a cutting team. However, a single squad may be required to perform both sets of duties.

4.1 Assembly Group

Whenever possible, the members of the Assembly Group should be assigned the following functions:

- **Shoring Officer (Rescue Squad Officer):** is in charge of the operation. Also works with structural specialists (if available) to determine where to place shores. If a Safety cannot be designated, the Shoring Officer will also take on this role.

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- **Measurer:** measures all shoring components and relays the information to the layout person of the cutting team.

- **Two Shorers:** these work together assembling and erecting shores in place.

- **Safety:** responsible for overall safety of the assembly team.

- **Runner:** Ensures tools, equipment and shoring materials are moved from the shoring operation primary access point to the shoring site and assists in the erection of shores as needed.

4.2 Cutting Group

Whenever possible, the members of the Cutting Group should be assigned the following functions:

- **Cutting Group Officer (Rescue Squad Officer):** in charge of selecting the cutting site. The site should be close to the shoring operation. The Cutting Team Officer doubles as the Safety.

- **Layout:** sets up the cutting station and records measurements. Performs all measuring and layout of angles.

- **Feeder:** moves and feeds measured and marked shoring material from the Layout to the Cutter and helps secure it during cutting.

- **Cutter:** cuts the measured materials.

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- **Tools and equipment person:** directs where materials and equipment are to be placed and moved, and is responsible for keeping track of all tools. This person is assigned to both the Cutting Group and the Assembly Group.

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- **Runner:** ensures tools, equipment and shoring materials are moved from the cutting area to the shoring operation primary access point.

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Assembly Group

Assembly Group Officer

Runner

Safety

Measurer

Two Shorers

Tools/ Equipment Person

Cutting Group

Cutting Group Officer

Layout

Runner

Feeder

Cutter

5. Building Shores (two types)

5.1 Nail Specifications

For the CSSR course, duplex (double-headed) nails of two sizes will be used. Using these nails makes disassembly easier. However, under actual rescue conditions, common nails of a similar size can be used.

All plywood (gusset plates) must be nailed using 8d nails only.

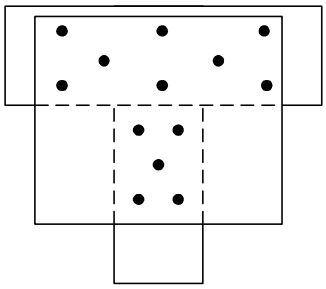
8d nail -- actual size (6.5 cm)

All dimensional wood must be nailed using 16d nails only

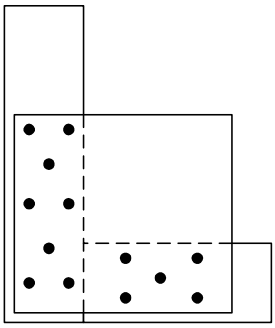
16d duplex nail -- actual size (9 cm)

The diagrams on the following page show the correct nailing patterns that should be used when shoring.

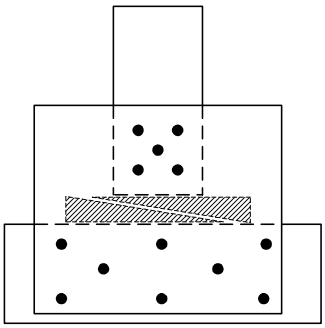
5.2 Recommended Nailing Patterns



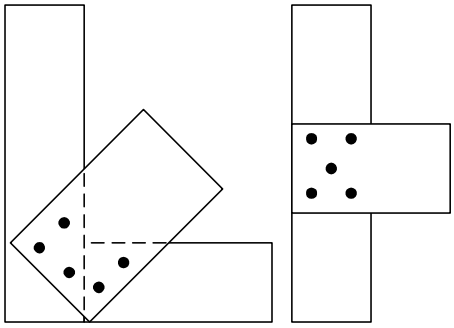
Top or bottom gusset plate on a vertical shore



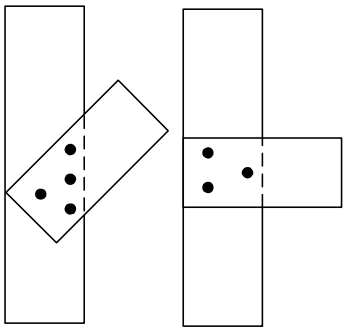
Corner gusset plate on a vertical shore



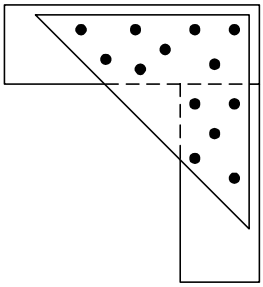
Bottom gusset plate with spaces for wedges on a vertical shore



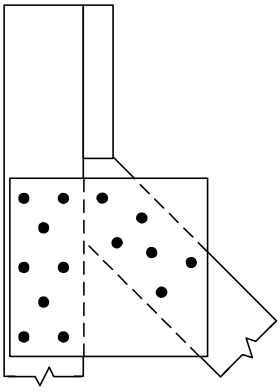
5 x 15 cm diagonal and midpoint braces



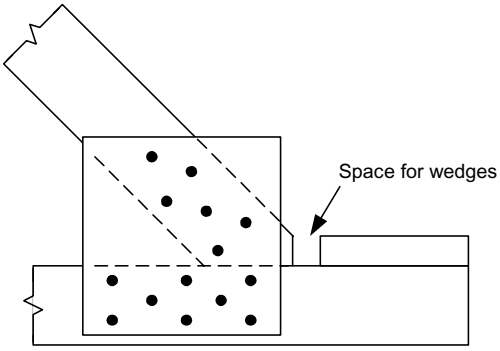
5 x 10 cm diagonal and midpoint braces



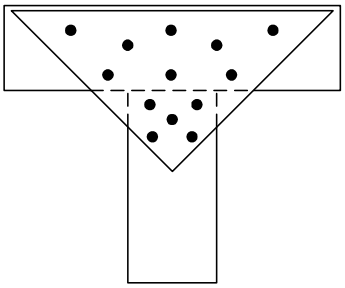
Triangular corner gusset plate



Raker top gusset plate



Raker bottom gusset plate



Triangular gusset plate on a vertical shore

5.3 Vertical Shore

The two sizes of lumber most commonly used in vertical shoring are 10 x 10 cm and 15 x 15 cm. The estimated weight of the floor and its contents will help to determine the size of shoring materials and their spacing.

Businesses and commercial occupancies with heavier structural elements and greater floor height and/or loading may require 20 x 20 cm or even 30 x 30 cm lumber. The Structural Specialist should be used to help determine the correct size and placement of shoring materials.

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.....

Step 1. Determine where to erect the vertical shore.

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.....

- After installing initial temporary shoring as needed, clear the area of debris, down to the floor, removing thick carpeting if necessary. A clearance of approximately one metre wide is usually adequate.

.....

.....

- If the vertical shore is to bear directly on soil, examine the ground for stability. If the earth is soft, you should install additional supports under the sole plate to transfer the load over a wider area.

.....

.....

Step 2. Measure and cut sole plate and header.

- Lay the sole plate on the floor or ground directly under and in line where the header will be installed.

.....

- The sole plate should be as level as possible.

.....

Step 3. Measure and cut the posts to the proper height.

.....

- Place the header on top of the sole plate.

.....

- With the end of the tape measure on top of the header where the posts are to be installed, slide the tape up to the bottom of the structural element to be shored. Measure in at least three places deducting the width of the wedges to be used and use the **shortest** measurement.

.....

.....

Step 4. Attach cleats or gusset plates to the header and posts, on opposite ends and opposing sides.

.....

.....

- This will allow the diagonal braces to be attached directly to the header, posts, and sole plate.

.....

.....

Step 5. Install the posts and the header on top of the sole plate to support the damaged structural element.

.....

.....

- The first two posts are installed at opposite ends at least 30 cm, but less than 60 cm from each end of the sole plate.

.....

- Keep the posts in line and plumb with header and sole plate.

.....

- Shim the structural elements down to the header to keep it as level as possible

.....

Step 6. Install a set of wedges under the bottom of each post.

.....

- Tap them together simultaneously until the posts are under compression and tight.

.....

- Nail behind the wedges to secure them in place.

.....

Note: You may want to use duplex nails to allow for adjustment of the wedges later on.

Step 7. Attach cleats or _____ _____ on opposite ends and opposing sides of the sole plate and posts and nail in place.

.....

Step 8. Attach the diagonal braces to each side of the vertical shore.

.....

- Mid-point braces, when needed, should be installed prior to the diagonal braces (except when 5 cm material is used, and then the mid-point braces are placed over the diagonals)

.....

.....

- The diagonal braces should be long enough to span its entire length and be attached to the sole plate and header and each post.

.....

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- If possible, diagonal braces should be installed in an X-pattern on opposite sides of the system.

.....

- Vertical shoring systems that span a long area may require several sets of diagonal braces to connect multiple posts.

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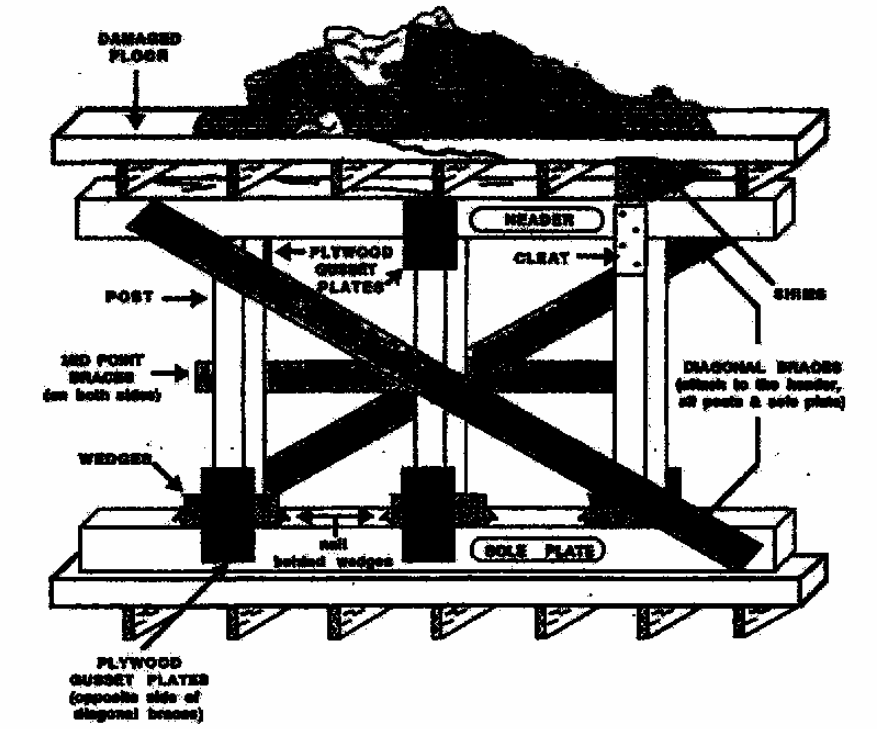

Additional notes on building a vertical shore: .....

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.....

5.4 Window/Door Shore

The window and door shore is usually installed in entry points intended for use by rescue personnel to hold up or stabilise loose headers or lintels that have lost their integrity.

Additional load stress is usually exerted from above and therefore, constructed similar to the vertical shore. If additional load stress is exerted from the side, the window and door shore is constructed similar to the horizontal shore.

.....

.....

Step 1. Determine where to erect the window/door shore.

.....

After initial temporary shoring has been installed, clear the area of debris or remaining framing material.

.....

.....

Step 2. Measure and cut the sole plate to the proper length deducting the width of the wedges to be used.

.....

Step 3. Measure and cut the header to the proper length deducting the width of the wedges to be used.

.....

- Prefabricate a built-up header, if required (see end of procedure).

.....

Step 4. Measure and cut the posts to the proper height.

.....

- Place the header on top of the sole plate.

.....

- With the end of the tape measure on top of the header where the posts are to be installed, slide the tape up to the bottom of the structural element to be shored on both sides deducting the width of the wedges to be used.

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- If you get two different measurements, use the shorter of the two.

.....

Step 5. Install the sole plate with a set of wedges at one end and tap them together simultaneously until the sole plate is under compression and tight.

.....

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- The sole plate should be as level as possible, using shims as necessary under the sole plate.

.....

.....

Step 6. Install the header with a set of wedges at the opposite end of the sole plate and tap them together simultaneously until the header is under compression and tight.

.....

.....

- The header should be as level as possible, use shims as necessary above the header.

.....

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Step 7. Install the posts between the header and sole plate and against the sides of the opening.

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Install the first post under the wedge-side of the header to prevent accidental movement if the header wedges loosen up.

.....

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Keep the posts in-line and plumb with the header and sole plate.

.....

Install a set of wedges under each post, on top of the sole plate. Then tighten the wedges to lock the shore in place.

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Step 8. Attach cleats or gusset plates to at least one side of the header and posts and nail in place.

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Step 9. Confine the wedges by placing a cleat against the inside face of each post at the bottom and nail them in place with five 16d nails to each post and two 16d toe-nails to the sole plate.

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- Future adjustment of the wedges may be required. Duplex nails can be used to allow for this.

.....

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Step 10. Install diagonal braces on the window and door shore when the opening is not used for access or egress.

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Built-up Header

A built-up header is used when additional support is needed or if the opening is more than 1.8 metres wide and only 10 x 10 cm material is available.

Prior to installation of the header, cut two 10 x 10 cm beams to proper length for header and set them one on top of the other. Place 15 cm-wide plywood strips (same length as the headers) on each side to join the two pieces, and hammer 8d nails at 8 cm on-centre from each strip of plywood to each 10 x 10 beam.

- Total nailing will be two rows of 8d nails spaced at 8 cm on-centre, per side.
- The header will be 20 cm thick, equivalent to a 10 x 20 cm beam.

Additional notes on building a window shore: .....

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10 Lifting and Stabilising Loads

<< Instructor's Copy >>

Objectives

Upon completing this lesson, you will be able to:

1. List three factors that you must determine before lifting a load.
2. List and describe three methods for lifting a load.
3. Define a lever, its three components and the three classes of a lever.
4. List at least three applications of the hoist.
5. List two types of cribbing used to stabilise a load.
6. List the five steps to build cribbing for lifting and stabilising a load.
7. List the steps to roll a load using pipes.
8. Demonstrate in three practical stations the techniques for lifting, stabilising and rolling loads.

Approximate Duration:

– Lecture: 1 hour
– Practical component: 3 hours

1. Before Lifting or Moving a Load

The following factors must be examined before lifting or moving a load:

- Weight of the load

  .....

  .....

- Consequences when the load is moved (what will happen)

  .....

  .....

- Selection of the method for lifting or moving the load

  .....

  .....

2. Methods for Lifting Loads

2.1 The Lever

The lever is the ***simplest*** method for lifting a load. A lever is a rigid bar, either straight or bent, that is free to move on a fixed point called a ***fulcrum***.

The fulcrum is the object or place that supports the load when a lever is used to move another object.

Applications of levers:

- To move a load that is too heavy to move by hand
- Pulling / hauling
- Raising

There are three components that make-up a lever: **fulcrum, load,** and **force**.

Fulcrum: .....

Load: .....

Force: .....

Three Classes of Levers

Levers are divided into three classes based on where the fulcrum is located in relation to both the load and force.

Class One Lever: The fulcrum is placed between the force and the load, which provides the greatest mechanical advantage when lifting a load vertically. You can increase the mechanical advantage by using a longer lever.

Examples:

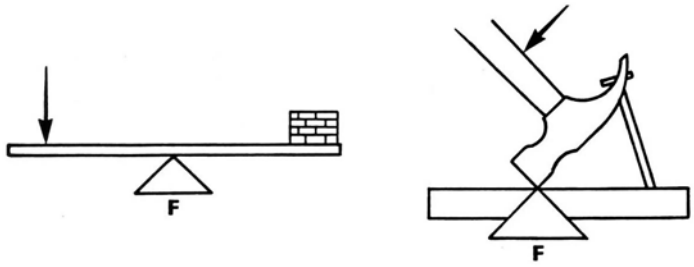

Figure 1 Class One lever examples (F=fulcrum).

Class Two Lever: The load is placed between the force and the fulcrum. This is the most useful and efficient lever for moving objects horizontally.

Examples:

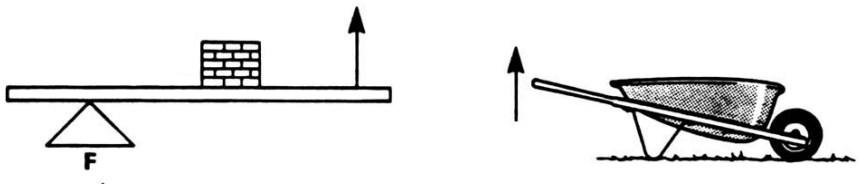

Figure 2 Class Two lever examples.

Class Three Lever: The force is placed between the load and the fulcrum. This type of lever is used when force may be sacrificed for distance, and reduces mechanical advantage.

Examples:

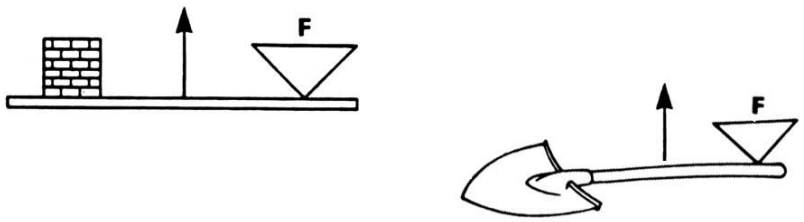

Figure 3. Class Three lever examples.

2.2 The Hoist

The hoist, also known as a ***come-along***, provides mechanical advantage for lifting and pulling using a lever and gear ratcheting system. It consists of an anchor hook on one end and another hook attached to a retractable chain or steel cable.

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Figure 4. The hoist.

The following figures show the many uses of the hoist.

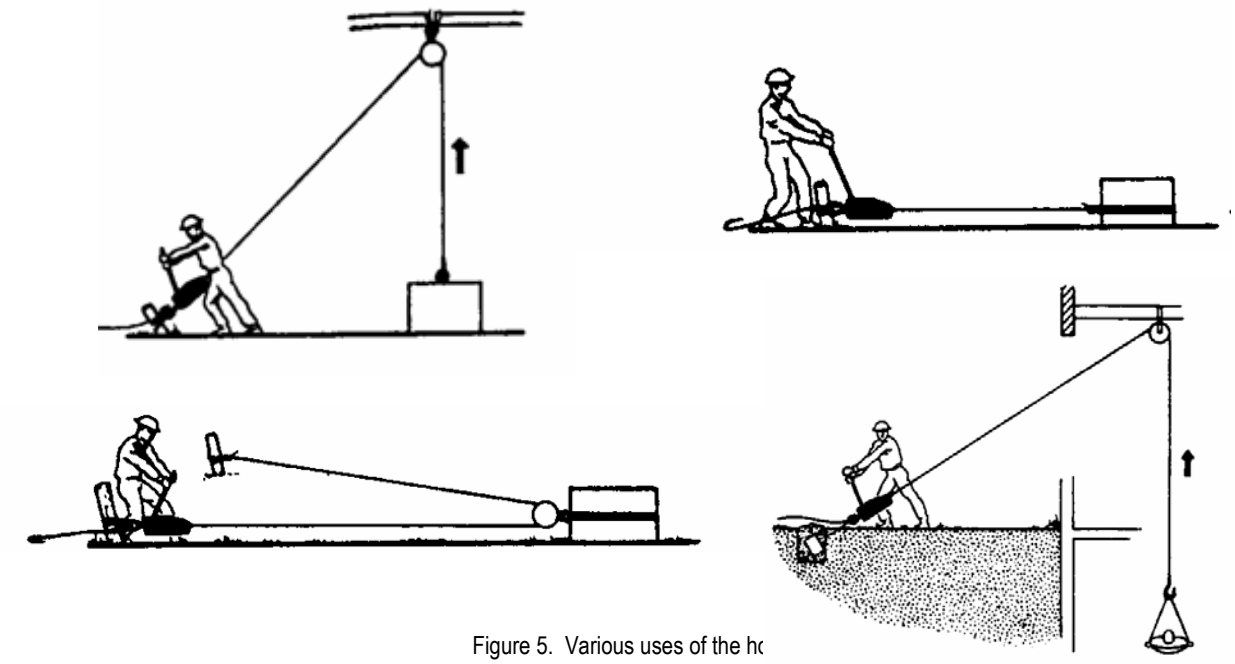

Figure 5. Various uses of the ho

2.3 Hydraulic Jacks

These devices are operated with a lever to apply ***hydraulic pressure*** to a ram. Hydraulic jacks are used primarily for lifting heavy loads. Though they usually have only a short reach, they are extremely powerful – a hand-operated bottle jack can lift as much as 50 tons. It is important to keep the hydraulic jack ***perpendicular*** to the ground – the jack is not designed to handle lateral loads.

.....

.....

Figure 6. Various bottle jacks.

3. Using Cribbing to Stabilise Loads

Cribbing: The construction of a stable platform using wood pieces, which is used to stabilise and support loads.

Cribbing is constructed of _____-sized wood pieces arranged as a column to support the weight of an object. _____ are used to fill in small spaces and secure the object in its position as it is being lifted. Shims are also used to change the angle of thrust in order to achieve optimum contact with uneven or sloping surfaces.

.....

.....

Failure of a wood cribbing system is ***slow*** and ***noisy*** as the wood fibres are crushed. This usually provides ample warning of impending failure for rescuers.

.....

.....

The requirements for improvised cribbing are:

- The material must be flat on both surfaces
- The material must be able to withstand the weight of the object being supported.

Examples include: Furniture, bricks, concrete blocks, tires, and rims

3.1 Types of Cribbing

BOX: Built with wood blocks in a square configuration, using ***two*** parallel blocks per layer. Layers are set at 90 degrees to each other with the ends of the wood blocks overlapping each other by ***10*** cm. The box crib has an open centre.

Box Cribbing Capacity
10 cm x 10 cm beams: 11,000 kilos
15 cm x 15 cm beams: 27,000 kilos

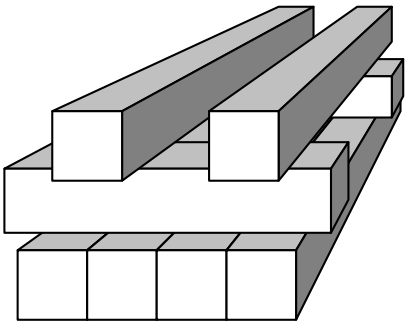

Figure 7. Box cribbing.

PLATFORM (cross-tie): Built with wood blocks in solid layers of ***three*** or more wood pieces each. Layers are set 90 degrees to each other. Little or no space is left between the wood pieces. The ends of the wood pieces must also overlap each other by 10 cm.

Platform Cribbing Capacity
10 cm x 10 cm beams = 48,000 kilos
15 cm x 15 cm beams = 120,000 kilos

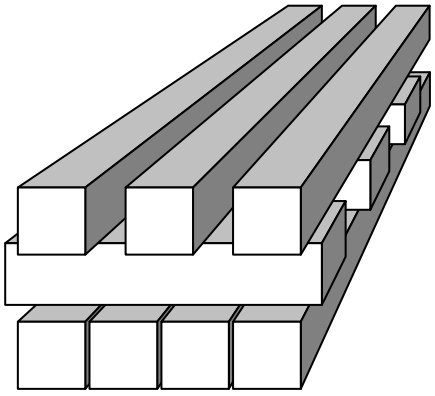

Figure 8. Platform cribbing.

3.2 General Guidelines for Cribbing

The first layer should be ***solid*** to fully distribute the load, especially on softer surfaces, such as soil and asphalt.

.....

.....

Height limit: The general rule is to limit cribbing to ***three*** times the length of the pieces of wood being used for cribbing (3:1 height-to-width ratio). For example, if the pieces of wood are one metre long, the cribbing should not exceed three metres in height.

.....

.....

Always overlap corners by approximately 10 cm. This prevents ***splitting off*** corners of individual pieces, which can affect overall stability.

.....

.....

3.3 Procedure for Lifting and Stabilising a Load

This procedure consists of gradually lifting the target object or load and inserting one layer of cribbing after another until sufficient clearance and stability are obtained. Make sure to use full PPE before starting any work.

1. Make an initial opening using a pry bar or similar tool.

   .....

2. Set up a lever system with the pry bar.

   .....

3. Lift the load ***gradually*** to create an opening large enough to set up the first layer of cribbing under it. Use wedges to prop up the load gradually as you are lifting; if the pry bar slips or breaks, this will prevent the load from dropping any distance. It is not necessary to lift the full height of the next layer of cribbing all at once.

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4. Raise the fulcrum, raise the load again, and set up the next level of cribbing with the wood pieces at 90 degrees to the previous layer.

.....

.....

5. Reposition and raise the fulcrum and continue to raise the load until enough clearance is obtained to extricate the victim safely.

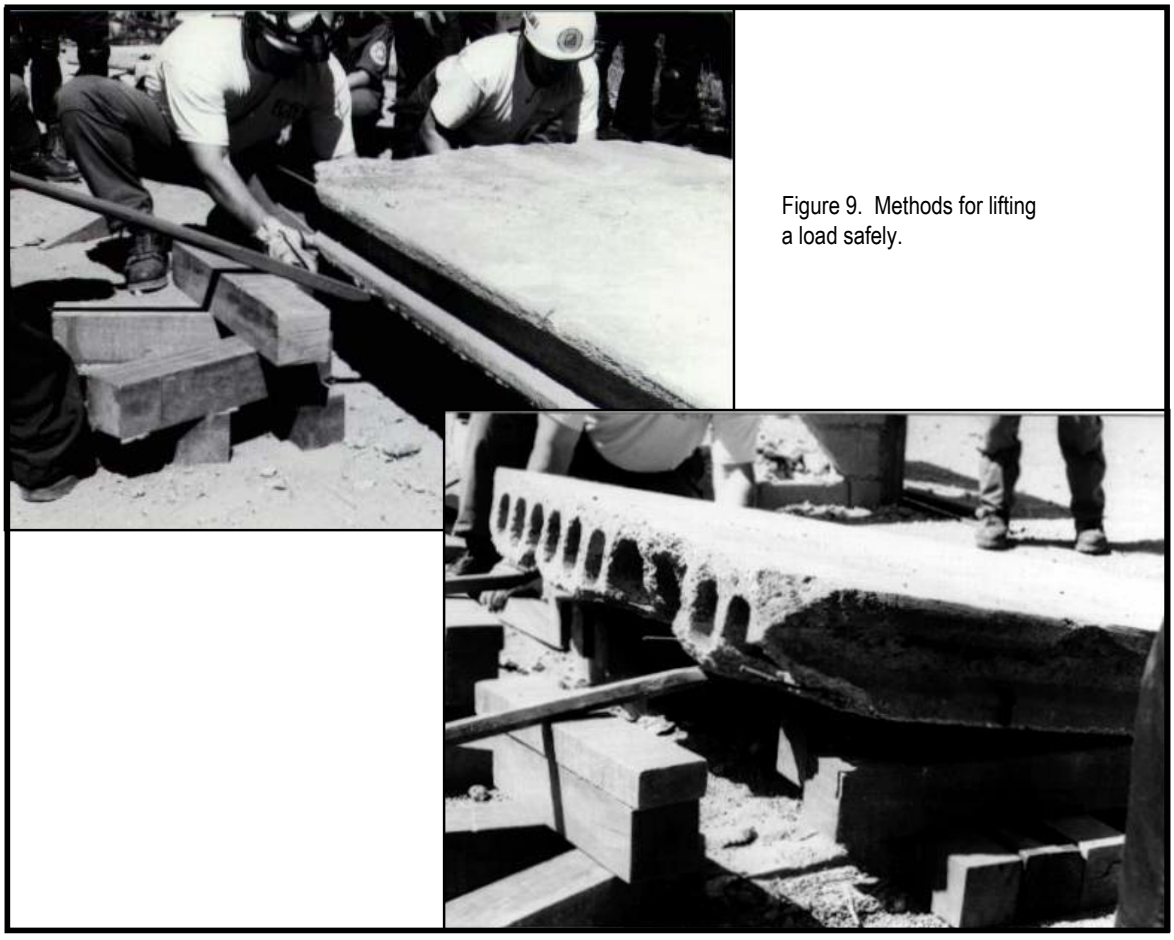

Figure 9. Methods for lifting a load safely.

3.4 Safety Measures for Cribbing

– "Lift an inch, crib an inch."

.....

– Never place hands beneath a load while cribbing!

.....

– For maximum stability, the height cribbing should not exceed three times the length of the cribbing blocks (3:1 ratio).

.....

4. Rolling a Load

You can use metal tubes to roll heavy loads instead of lifting them. Follow the simple steps below using the picture as a guide.

1. Raise the load slightly using a Class One lever, just enough to slide three metal tubes underneath it (use the lifting technique for cribbing).

.....

.....

2. Using Class Two levers, push the load in the desired direction. The tubes may be fanned to turn the load as it rolls.

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11 Pre-Hospital Treatment

<< Instructor's Copy >>

Objectives

Upon completing this lesson, you will be able to:

1. Identify the possible mechanisms of injury in a structural collapse.
2. List the potential injuries that could be expected in a structural collapse.
3. Describe the conditions in a patient that might indicate the presence of crush syndrome or compartment syndrome.

Approximate Duration:

– Lecture: 1 hour
– Practical component: None

1. Mechanisms of Injury and Their Consequences

It is very important for the rescuers not to lose sight of the primary objective of a CSSR operation. Their first responsibility is to assess, stabilise and extricate victims with the least possible injury.

1.1 Crushing or compression

- ***Compartment syndrome***
- ***Crush syndrome***
- ***Wide variety of fractures***
- ***Internal haemorrhaging***

.....

.....

.....

1.2 Falls

- ***Fractures of the extremities, skull and spinal column***
- ***Internal and external haemorrhaging***

.....

.....

1.3 Low temperatures

- ***Hypothermia and associated complications***

.....

.....

1.4 Blunt Trauma

This can be caused by impact by furniture, loose objects or materials from the structure (at high velocity in explosions).

- ***Internal and external haemorrhaging***

.....

- ***Shock***

.....

- ***Various injuries***

.....

- ***Severe contusions***

.....

1.5 Contaminated air

It is common in collapsed structure situations to encounter large amounts of airborne dust, and in some situations hazardous and/or flammable vapours.

- ***Respiratory difficulties***

.....

- ***Cardiac arrest***

.....

- ***Respiratory arrest***

.....

- ***Neurological problems***

.....

1.6 Lack of water and food

- ***Dehydration***

.....

- ***Starvation***

.....

- ***Shock***

.....

- ***Renal failure***

.....

1.7 Prolonged isolation and desperation

- Traumatic stress

.....

2. Crush Syndrome

Complications resulting from blood toxicity that arise after an extremity or muscle mass has been compressed and circulation compromised for an extended period of time.

Crush syndrome can result when an extremity is caught under pressure between two objects. It is common in trapped victims of collapsed structures. Swelling may be a major problem with resulting loss of blood supply distally. Patients may suffer (tourniquet shock) when the object is removed and toxins that have been built up behind the blockage are released and travel to the heart with often ***fatal*** results.

According to studies on patients with crush syndrome, if they receive proper treatment in a timely manner, there is a **60** percent chance of remaining alive. Crush syndrome does not necessarily occur in every incident where a victim is trapped. As a general rule, the syndrome may be considered present on the basis of three criteria:

- involvement of a ***muscle mass***
- prolonged ***compression***
- compromised ***circulation***

For instance, entrapment of a hand is unlikely to initiate the syndrome. Compression time may be as short as one hour but the average time is four to six hours or greater.

The major problem that faces the rescuer when dealing with suspected crush injury is dissuading helpful bystanders from attempting to remove the compressive force prior to treatment.

Signs and symptoms of crush syndrome

- Anxiety
- Difficulty breathing
- Decreasing blood pressure
- Changes in body temperature

- Rapid pulse .....
- Cardiac deficiency .....
- Loss of consciousness .....
- Absent pulse and capillary refill in the distal limb

  .....
- Shock .....

3. Compartment Syndrome

An increase in pressure in the closed space of the muscle caused by tissue swelling that causes destruction of **MUSCLE FIBRES** and **NERVES**.

.....

.....

Compartment syndrome usually develops over a period of several hours and may not be present initially. It may be the result of crush syndrome, closed or open fractures, sustained compression, or after blood flow has been returned. As the duration and magnitude of interstitial pressure increases, necrosis of soft tissue eventually develops. While compartment syndrome can occur in most areas of the body, the more common sites are the forearm, calf and thigh.

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There are two prerequisites for compartment syndrome to occur:

- An envelope within the tissue that limits the available space

  .....
- A cause of increased pressure within the envelope

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Signs and Symptoms

- Swollen limb in an unconscious patient .....
- Severe pain, disproportionate to the injury .....
- Pain on passive stretching of the muscles in the compartment .....
- Diminished pulse .....
- Poor capillary refill .....
- Decreased sensation in the affected extremity .....
- Shock .....
- Dehydration .....
- Loss of motor function in the affected limb .....

4. General Treatment for Trapped Patients

1. Do not remove the source of pressure until treatment has begun.

   .....

2. ***Check*** **ABC'S**

   .....

3. Protect the patient from possible hazards resulting from the rescue attempt.

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4. ***Administer oxygen***

   .....

5. Immobilise the neck and spine.

   .....

6. ***Maintain body temperature***

   .....

7. Protect the patient from the environment.

   .....

8. Monitor the patient's cardiac state.

   .....

9. Allow qualified medical personnel to provide the ***required treatment.***

   .....

10. Place the patient on the backboard or stretcher, immobilise him or her, and proceed with removal from the site, using correct procedure at every step.

.....

11. Remember the protocols for contact with victims that were covered in Lesson 6.

> The specific treatments for crush syndrome and compartment syndrome must be administered by qualified emergency medical personnel. Consult the reference material for this lesson.

5. Immobilising a Patient on a Backboard

1. Stabilising the patient's head.

.....

2. Place the ***cervical collar***.

.....

3. Rotate the patient onto the backboard.

.....

4. Inspect the ***patient's back***.

.....

5. Centre the patient on the backboard.

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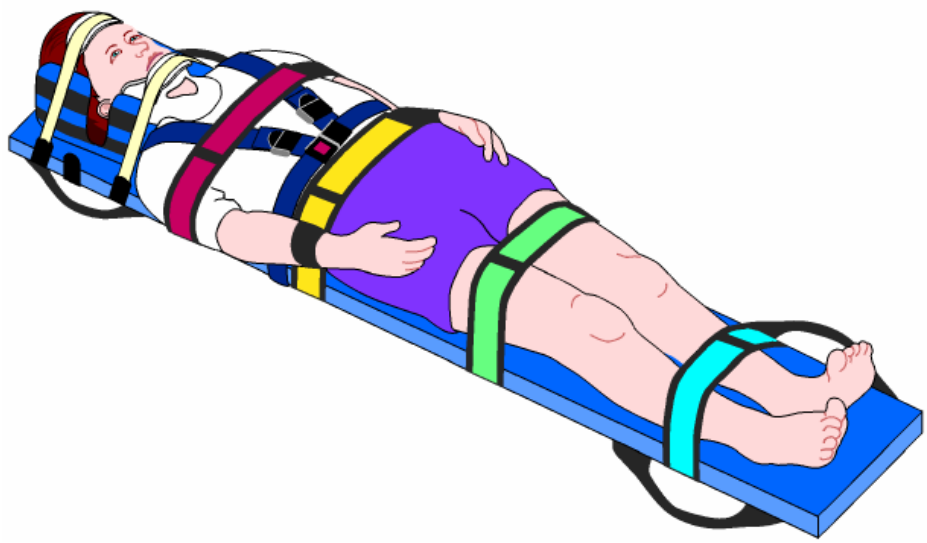
6. Immobilise the patient onto the backboard.

.....

7. Check pulse, motor function and sensation after immobilising the patient.

.....

Correct Immobilisation



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12 Final Practical Exercise

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Phase 1

Phase 2

Phase 3

1. Purpose

To demonstrate the knowledge, techniques and skills learned in the CSSR Course, to take the required steps when arriving on the scene, searching, locating, stabilizing and extricating a simulated victim in a simulated collapsed structure.

2. Performance Objectives

Upon completing the CSSR Course, you will be able perform the following tasks as part of a 10-12 member CSSR team:

1. Describe the correct initial steps that must be taken when arriving at the scene and before initiating a search.
2. Apply search techniques for trapped victims.
3. Gain access to void spaces in order to locate potential victims, using three basic techniques (removing rubble, shoring, and penetration).
4. Correctly stabilize and extricate a simulated patient.

The Final Practical Exercise will be divided into **three phases**.

3. Tools, Equipment and Supplies

In order to complete the performance objectives, each work group will be given three consecutive simulated scenarios and the following general equipment and supplies:

3.1 Phase I

- Slide projector with replacement bulb
- Two (2) slides of collapsed structures
- Two (2) blank questionnaires
- Two (2) clipboards for note-taking
- Ten (10) blank sheets of paper
- Two (2) pens (blue or black ink)

3.2 Phase II

- Two (2) clipboards with note pads
- One (1) megaphone
- Ten (10) blank sheets of paper
- Two (2) pens (blue or black ink)

3.3 Phase III

- Four (4) pry bars
- Two (2) crowbars
- Four (4) sledgehammer
- Two (2) flat chisels
- Two (2) diamond-point chisels
- Two (2) chipping hammers
- Two (2) axes
- Two (2) hatchets
- Four (4) saws
- Four (4) hacksaws with 3 replacement blades for each (12 blades total)
- Two (2) vise grips
- Two (2) pairs of pliers
- Two (2) pipe wrenches
- Two (2) crescent/adjustable wrenches
- Two (2) slotted screwdrivers
- Two (2) Philips screwdrivers
- Two (2) files
- Two (2) hand drills
- Four (4) shovels
- Four (4) picks
- Two (2) machetes
- Four (4) brick hammers
- Two (2) orange spray paint cans

- Two (2) sisal ropes, 30 metres
- Four (4) flashlights
- Two (2) tarps, 4 x 4 metres
- Two (2) measuring tapes, 3 metres
- Thirty-two (32) wood blocks, 10x10x45 cm
- Two (2) wood beams, 10x10 cm x 3 m
- Seven (7) wood beams, 10x10 cm x 5 m
- Eight (8) wood beams, 5x10 cm x 2.5 m
- One (1) plywood board, 12 mm thick, 1.25 x 2.5 m
- Forty-eight (48) wood shims
- Thirty-two (32) wood wedges
- Two hundred (200) nails
- Two (2) backboards
- Four (4) elastic bandages
- Two (2) cervical collars, adult

Optional Tools

- Two (2) "Jaws of Life"
- Two (2) hydraulic jacks (20-ton capacity)
- Two (2) chainsaws
- Two (2) electric/battery-powered drills
- Two (2) circular saws
- Two (2) air chisels
- Two (2) portable electric generators
- Two (2) rotary rescue saws

You must use your own complete set of personal protective equipment. You must complete all three phases within nine (9) hours, following the techniques and procedures learned in this course.

The Final Practical Exercise will be conducted in a field location with three simulated scenarios.

4. Procedure Checklists

Total time limit for all phases: **9 hours**
Total number of instructors: **6 instructors, 2 assistants**

4.1 Phase I: Organising and Starting a CSSR Operation

Time Limit: **45 minutes** (there may be an activation call for a CSSR operation up to 3 hours before the start of Phase I)
Number of Instructors: One lead instructor, one assistant

Sequence

1. Organise group and assign specific duties for scene assessment.
2. Take required safety precautions.
3. Conduct preliminary study to estimate the number of potential trapped victims.
4. Establish work areas based on the scene.
5. Identify the type of structure.
6. List any additional resources required.
7. Identify risks.
8. Place marks on structures as required.
9. Other actions the group must take before initiating search.

4.2 Phase II: Search

Time Limit: 45 minutes
Number of Instructors: One lead instructor, two assistants

Sequence

1. Gather information from neighbours, relatives and personnel in charge of the building.
2. Complete inspection of building (360 degrees, if possible).
3. If available, obtain plans, photographs, or diagram of building.
4. Consult a structural engineer regarding safety before allowing rescue personnel to enter structure.
5. Develop plan of action to conduct search.
6. Assign tasks to team members appropriately.
7. Establish and prioritise areas with greater chance of having trapped victims.
8. Prepare and use a grid or coordinate system to ensure that all areas of the structure have been searched.
9. Locate all possible access points.
10. Use the call and listen method correctly.
11. Use the sound transmission method correctly.
12. Consider the possible use canine teams or other alternative search methods.
13. Locate the possible trapped victim with minimum margin of error.

4.3 Phase III: Removal, Shoring, Lifting, Penetration and Rescue

Time Limit: 5 hours

Number of Instructors: One lead instructor per simulator, two assistants

Sequence

1. Select the correct tools and materials required.
2. Build horizontal shoring.
3. Cut and penetrate the wood/metal wall.
4. Break and penetrate the cinder block wall.
5. Break and penetrate the brick wall.
6. Break and penetrate the concrete wall.
7. Conduct complete patient assessment before moving the patient.
8. Lift the concrete pad to remove the patient. (shouldn't this come before #7?)
9. stabilise and immobilise the patient on long backboard before extrication.
10. Bring out the patient correctly through all the walls.
11. Maintain all safety measures throughout the entire operation.
12. Conduct the operation as a team, with proper rotation and task distribution.

Team Grade Sheet

TEAM NUMBER	START TIME	END TIME
Team Member Names 1. _____ 2. _____ 3. _____ 4. _____ 5. _____ 6. _____ 7. _____ 8. _____ 9. _____ 10. _____ 11. _____ 12. _____		
NOTES		

Instructor Signature		Team Leader Signature	
Date	Score	**PASS**	**FAIL**

Phase I
Team Questionnaire

This exercise is a simulation of a collapsed structure incident. Based on the image with which you are presented, you will need to answer the questions and complete the steps outline in this questionnaire. You will have 20 minutes to complete this questionnaire. Once your team has completed it or you have reached the time limit, turn it in to the instructors.

Recommendation: Be objective, brief and technical in your responses.

1. Draw a flowchart in the space below showing how your team organized and distributed specific CSSR tasks upon arriving at the scene.

2. List five safety precautions that must be implemented upon arriving at the scene and before starting operations in the collapsed structure.

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3. Calculate a preliminary estimate of the number of potential victims trapped in the structure. Explain how you made your calculations.

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4. Using the Site Sketch form included in this questionnaire, draw a diagram of the collapsed structure scene.

5. Identify the type of structure being analysed in this exercise (reinforced concrete, wood, brick, etc.).

_____

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6. List the additional resources (personnel and material) that you think should be requested for this scene during the next eight hours.

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7. Identify the potential risks that your personnel may encounter once rescue operations are initiated in the collapsed structure.

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8. Using the Site Sketch form on the following page, draw a correct set-up for cordoning off the area and marking buildings before the search begins.

Search Area/Site Sketch

Team # _____ Date: _____ Time:_____ Location/GPS _____ Page: ____ of _____

	A	B	C	D	E	F	G	H	I
1									
2									
3									
4									
5									
6									
7									
8									
9									

Legend / Required Symbols

- North arrow
- Scale
- Sides 1, 2, 3 and 4
- Access points: 1st → 2st →

Chemical

Structural

Environmental

Detected victim

Live victim L - 3

Dead victim D - 3

Resources Utilized

Physical/ Hailing ☐ Acoustic ☐

Canine ☐ Optical ☐ Other ☐

Cut services: E Electricity, G Gas, W Water

Command Post

Staging Area S

Emergency vehicles

Trucks

Heavy equipment

FINAL PRACTICAL EVALUATION
Demonstration and Practice Checklist

Group #:	Station:

	Team Activity*	Completed	Not Comp.
1	Squad organised CSSR functions among members at the start of the operation.		
2	**Gathered information based on the initial description and image provided in Phase I.**		
3	**Developed an action plan to conduct search, based on site sketch.**		
4	**Located the victim using the hailing method.**		
5	Placed the appropriate mark to indicate the presence of a potential live victim.		
6	**Used the proper techniques to break and breach walls.**		
7	**Built window/door shoring properly inside the module.**		
8	**Correctly performed initial assessment of patient and immobilised him on backboard.**		
9	**Extricated the patient, using the techniques for lifting and stabilising loads.**		
10	**Called out all required safety rules while carrying out their tasks.**		
11	Work was conducted as a team, with a good distribution of tasks.		

**Activities in bold type require satisfactory performance for a passing grade on this evaluation.*

Observations:			
Pass:		**Instructor:**	
Fail:		**Course Location:**	**Date:**
		Instructor Signature:	